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Design and Optimization of Drum Brake System for Heavy Vehicles

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ABSTRACT

This paper is based on the project "Power Assisted Gear Shifting Mechanism for Automobiles". This is a design, fabrication and implementation project. The project provides solution for skidding privilege in heavy vehicles. Majority of the road accidents takes place due to brake failure of the vehicles causing havoc to the safety of the security of the occupants and road users. It is imperative that an effective system of the braking is required to stop the vehicle within reasonable distance. The failure or malfunctioning of Brake causes damages to life and property. In the traditional or conventional braking system, two brakes linings are employed, in this Project work, Four Brake linings are embedded in the brake drum to uniformly distribute the torque to the drum apart from reducing wear and tear of the linings strategy is carried out. Further, automatic clutch can be incorporated with this unit to make it fully automatic.

Keywords: Wheel rim, Aluminum alloy, Magnesium alloy, Material reduction, Solid works and Ansys.

1. INTRODUCTION

Majority The Basic function of the brake is to slow the speed of the vehicle, when required, and to maintain its speed in downhill operation, and to hold the vehicle in stationary position after it has to come to stop, the failure or malfunctioning of Brake causes damages to life and property. When the brakes are hydraulically applied, the caliper clamps or squeezes the two pads together into the spinning rotor to slow/stop the vehicle. When a brake pad is heated by contact with a s transfers small amounts of friction material to the disc, turning it dull gray. The brake pad and disc (both now with friction material), then "stick" to each other, providing the friction that stops the vehicle. In disc brake applications, there are usually two brake pads per disc rotor, held in place and actuated by a caliper affixed to a wheel hub or upright. Depending on the properties of the material, disc wear rates may vary. The brake pads must usually be replaced regularly (depending on pad material), and most are equipped with a method of alerting the driver when this needs to take place. Some have a thin piece of soft metal that causes the brakes to squeal when the pads are too thin, while others have a soft metal tab embedded in the pad material that closes an and lights a warning light when the brake pad gets thin. More expensive cars may use an electronic sensor.

2. DRUM BRAKE

The main advantages of drum brakes is that they can apply more stopping power for a given amount of force applied to brake pedal compared to disc brake System. This is because the drum brake design

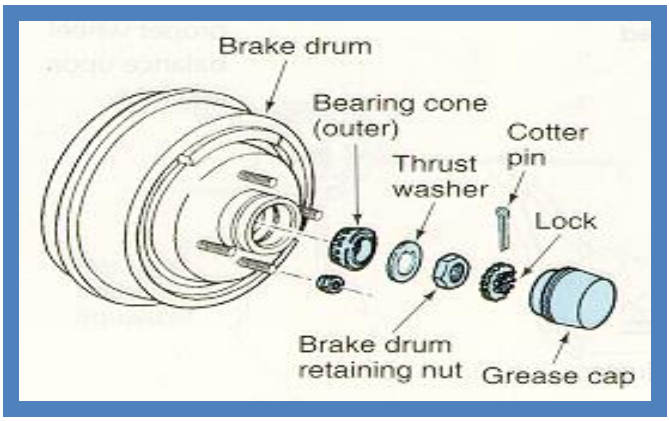

Fig 1

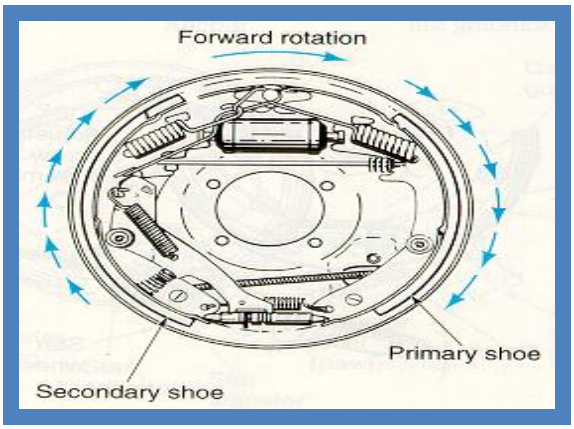

Fig 2

However, true magnesium wheels are very rare, usually found only on high dollar sports cars. Magnesium suffered from many problems. It was very susceptible to pitting and corrosion, and would start to break down in just a few months. Cracking was a common problem, and the wheels were very flammable. Magnesium is used for flares and early flash lamps. Magnesium in bulk is hard to ignite but, once lit, is very hard to extinguish, being able to burn under water or in carbon dioxide, which are common extinguishing materials. Tires that caught fire could soon ignite the magnesium, creating difficulties for fire responders. Magnesium wheels required constant maintenance to keep polished. Alloys of magnesium were later developed to help alleviate some of the problems.

3. PROBLEM IDENTIFICATION

3.1. In the Existing Model

- ✓ The wear occurrence of the brake shoe is uneven.
- ✓ Higher possibilities of skidding prevail.
- ✓ The strength of brake shoe material is apparently less.
- ✓ Heat generation is uneven. And dissipation is less.
- ✓ Stress distribution is not even. Life of brake shoe material is short.

Fig 3

3.2. Structural Analysis of Existing Brake Shoe

Similarly, the structural Analysis was made for Steel C15 and Steel C35. The Results in deformation, stress and strain is compared.

3.2.1 Deformation

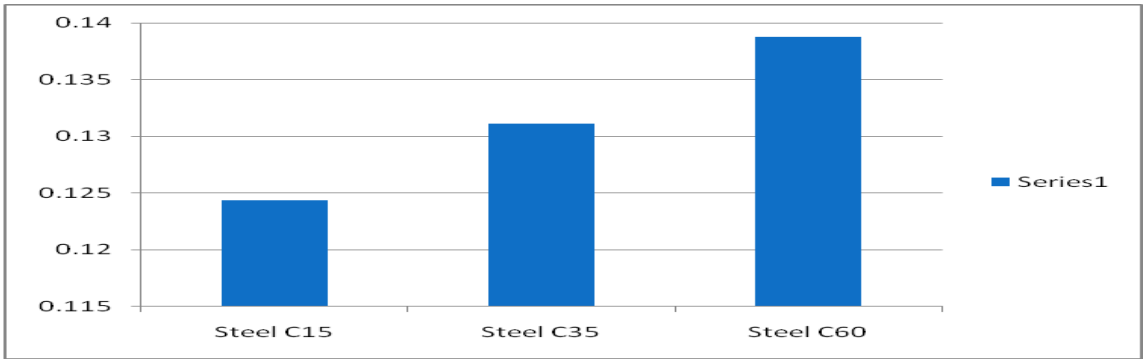

Fig 4

3.2.2 Stress

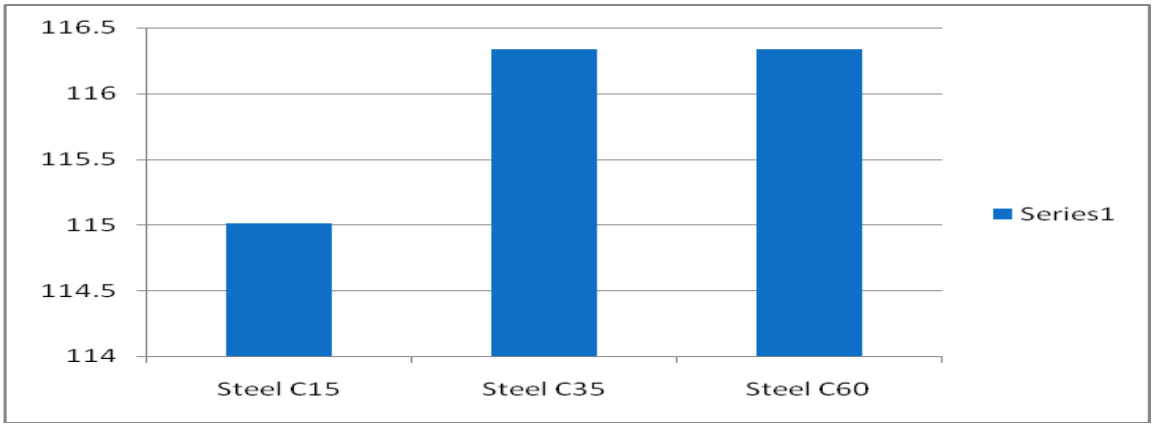

Fig 5

3.2.3 Strain

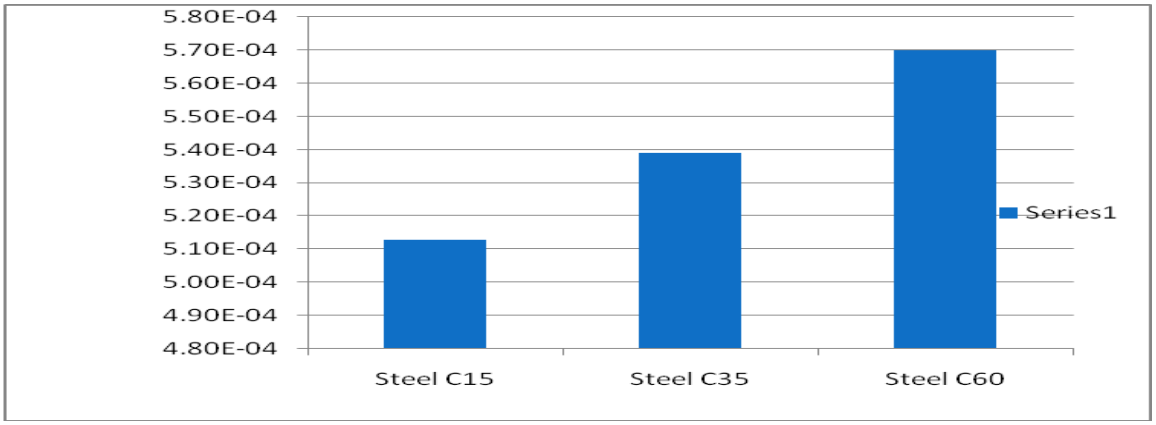

Fig 6

4. EXPERIMENTAL

4.1 Existing Model

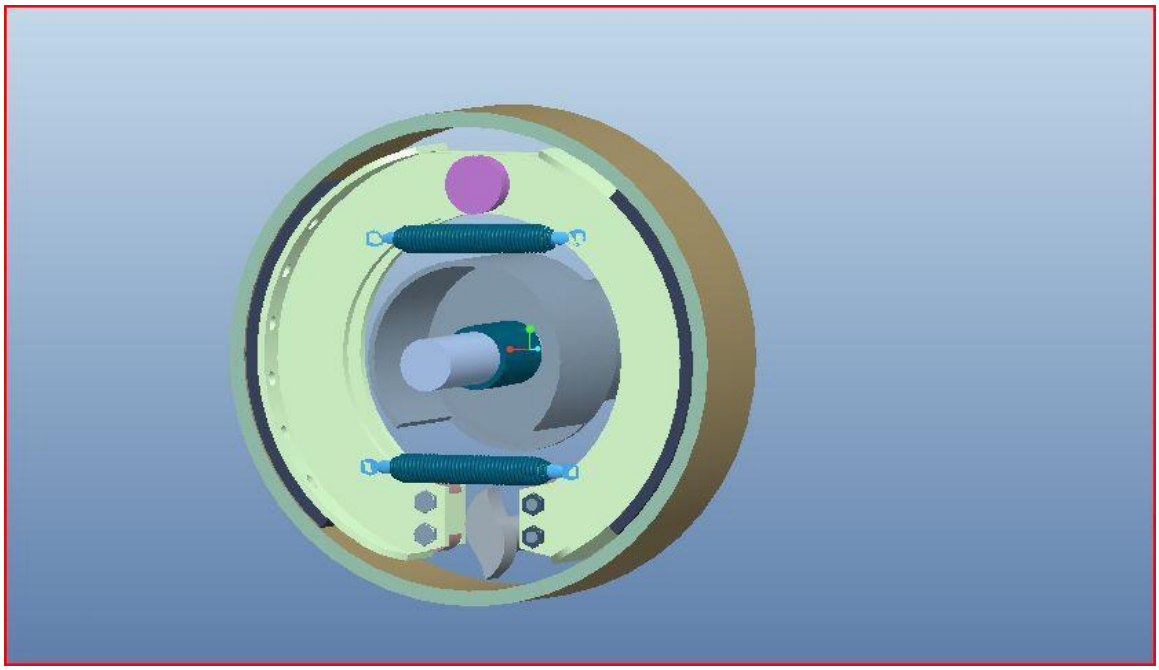

Fig 7

4.2 Modification in Redesign

- ✓ The two Brake shoe is split in four.
- ✓ In additional s-cam is installed in the bottom of the brake to actuate four brake shoes.
- ✓ An alteration in the position of the PIVOT is also made.

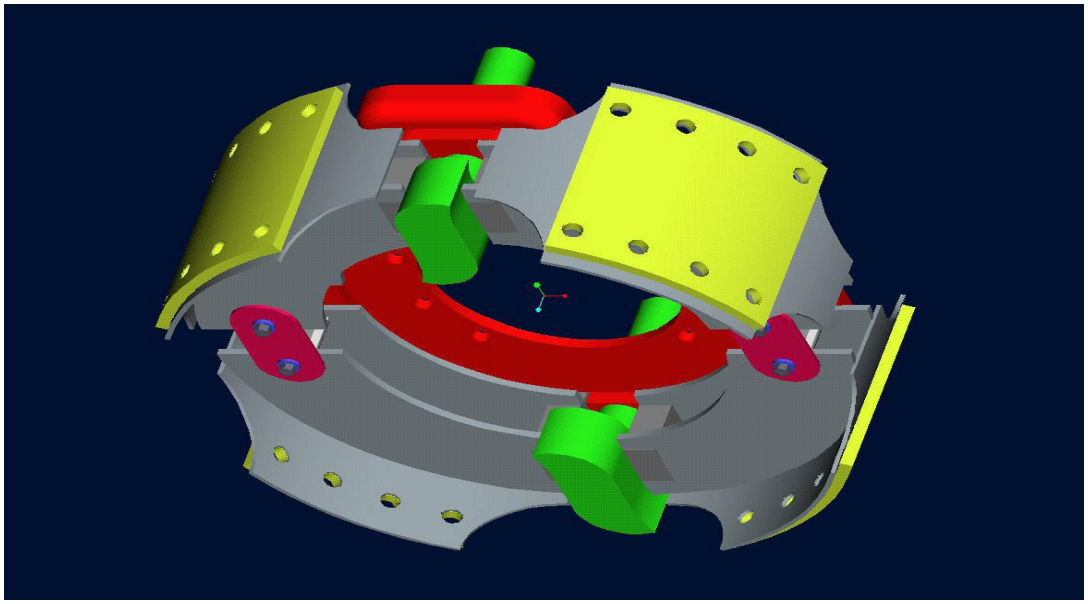

Fig 8

5. CHANGE IN LINING MATERIAL

The Brake shoe material STEEL C 60 is replaced with alternate materials like STEEL C 15 or STEEL C 35. The Brake pad material ASBESTOS is replaced with another alternative material ARAMID.

5.1 Thermal Calculation

Given;

Vehicle mass 'M' = 10ton = 10000/9.81= 1020kg
Vehicle speed 'V' = 40km/hr = 40000/3600 = 11.11m/s
c = Specific Heat = 840 J/kg °C
T1 = Air temperature = 30°C = 303k

Given;

Vehicle mass 'M' = 10ton = 10000/9.81 = 1020kg
Vehicle speed 'V' = 40km/hr = 40000/3600; 'V' = 11.11m/s
c = Specific Heat = 840 J/kg °C, T1 = Air temperature = 30°C = 303k
Now, Kinetic Energy of the vehicle = 0.5MV2
= 0.5 x 10,000 x (11.11)2 = 617160.5 J
Kinetic Energy at each wheel = ¼ 617160.5 = 154290.125 J
According law of conservation of energy and as per the problem statement,
Kinetic Energy = Work done = mc (T2- T1)
Kinetic Energy = mc (T2- T1)
154290.125 = 5x840(T2-30)
T2 = 67°C = 339 k

6. RESULTS AND DISCUSSIONS

1. The lower cost compared to a traditional Brake system as compared to another.
2. The ability to avoid the skidding resistance.
3. This project is an innovative concept.
4. Frictional wear rate of different lining material has to be done.
5. Skidding distance for existing design and Conventional design has to be calculated.
6. It is a new dimension in drum brake system for heavy vehicles

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